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South Korea offshore wind power overview

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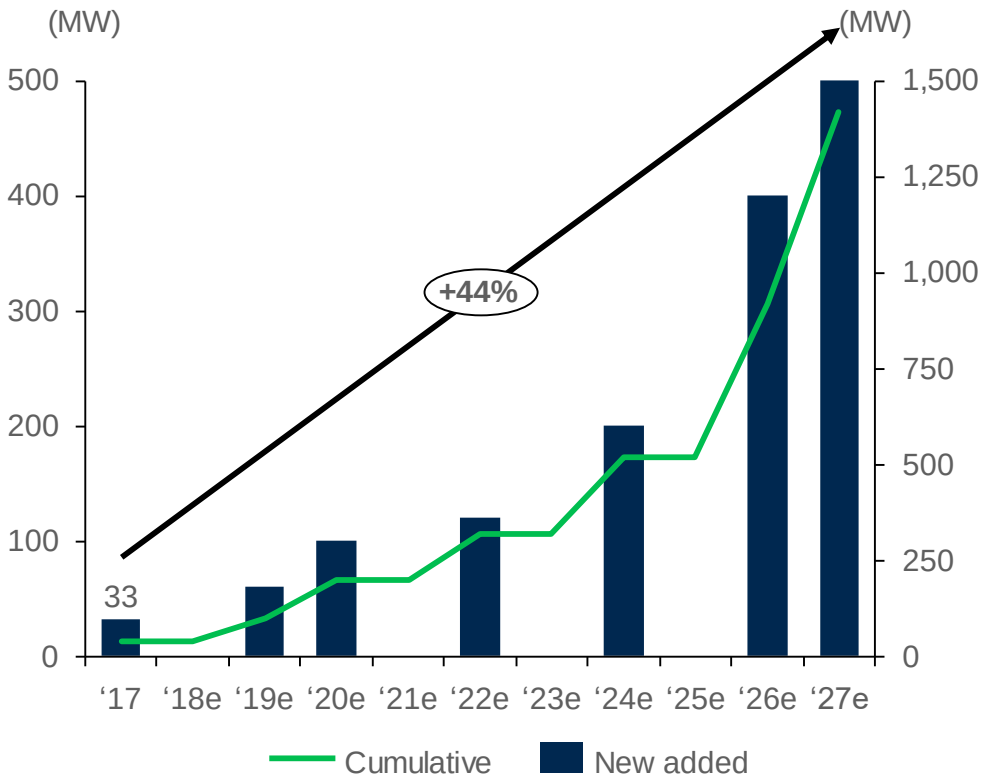
First to complete true utility scale offshore project

South Korea offshore outlook, 2017-2027e



Source: MAKE

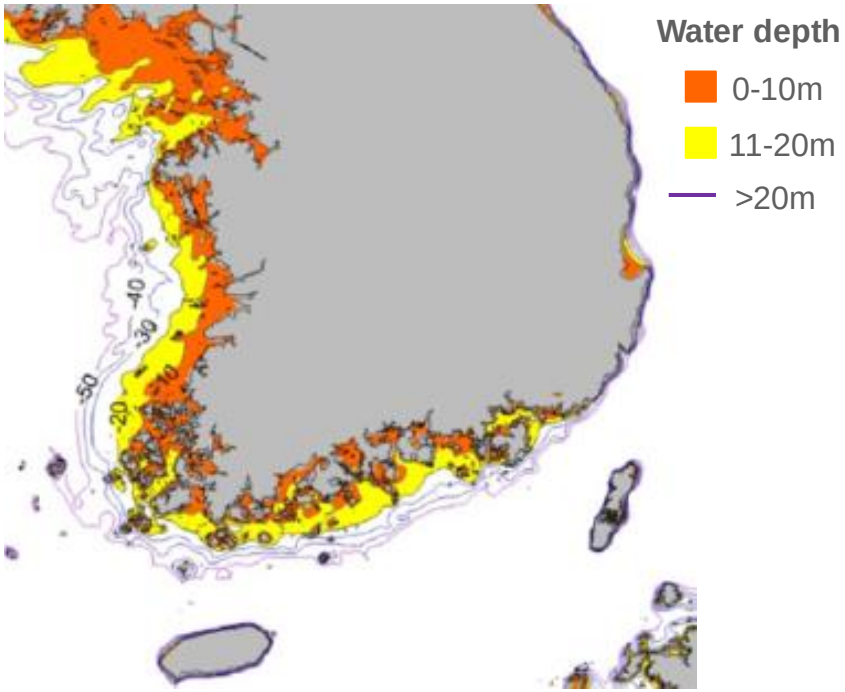
Offshore wind summary	
Offshore by YE/2017	38MW
Wind RPS system	Offshore REC weighting is 2.5:1
Wind* target	18GW by 2030 (13GW is offshore)
Average shore distance	~10km
Average wind speed	7.0m/s at 80m
Average water depth	~20m

Note: 1MWh generated from renewable energy = 1 REC
Offshore REC weighting decreases as project gets older
*Wind target includes both onshore and offshore wind

30MW Tamra offshore

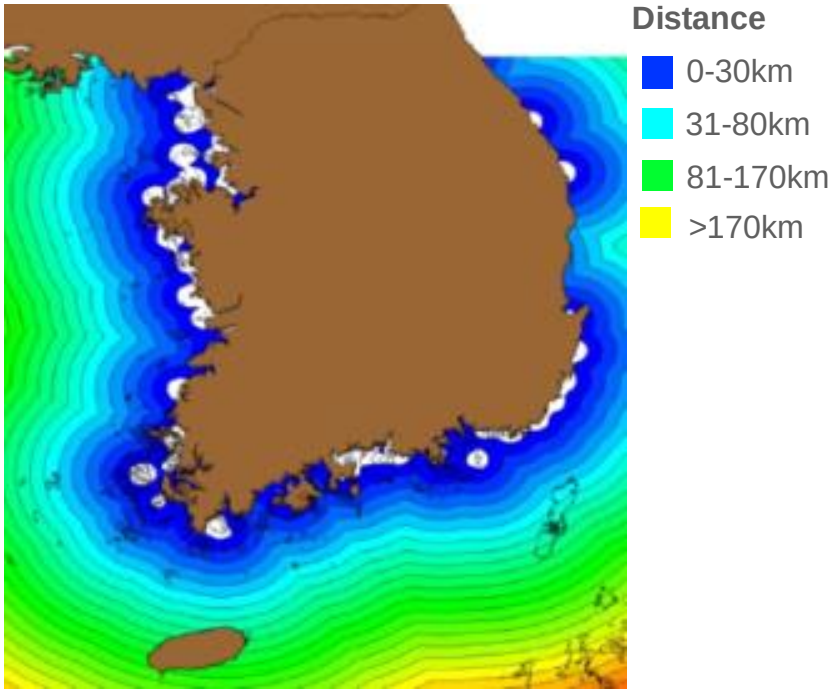
Water conditions suitable for grounded offshore projects

South Korea: coastline water depth



Source: MAKE, KEPCO

South Korea: distance from substation

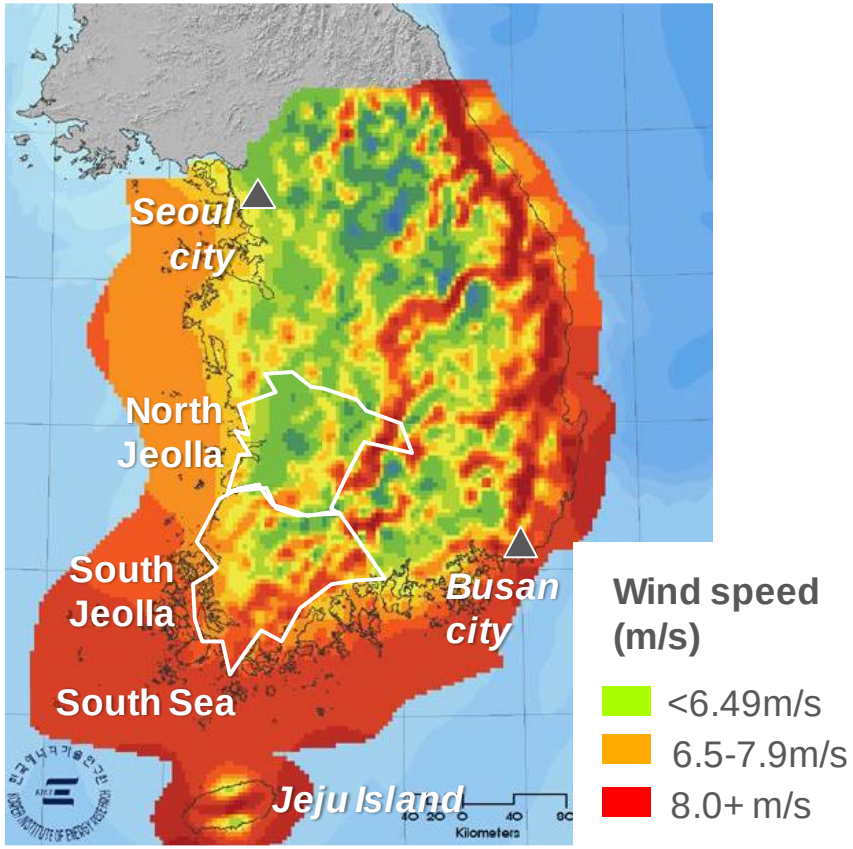


Source: MAKE, KEPCO

Despite favorable conditions for offshore wind development, South Korea is still subject to 3-4 typhoons every year during summer season

Rich offshore wind resources in Southern regions

South Korea offshore wind map



Source: MAKE. KIER

DRIVERS

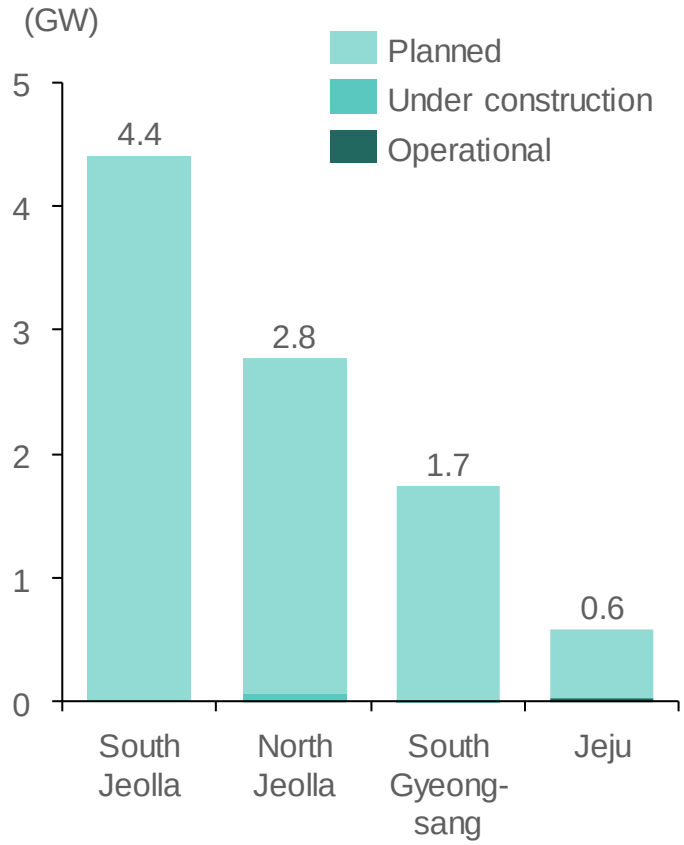
- **Offshore wind is identified as a potential high technology manufacturing sector:** Enables sector to receive national R&D support which govt. believes local companies can become world class
- **Parts of local supply chain are already integrated with global offshore wind supply chain**: Local cables, towers, forgings suppliers are already global offshore suppliers

BARRIERS

- **No installation vessels in South Korea:** There is no plans to import vessels from Europe and companies are actively looking for a local solution
- **Difficult negotiations with local population:** Particularly difficult with fishermen over high compensation

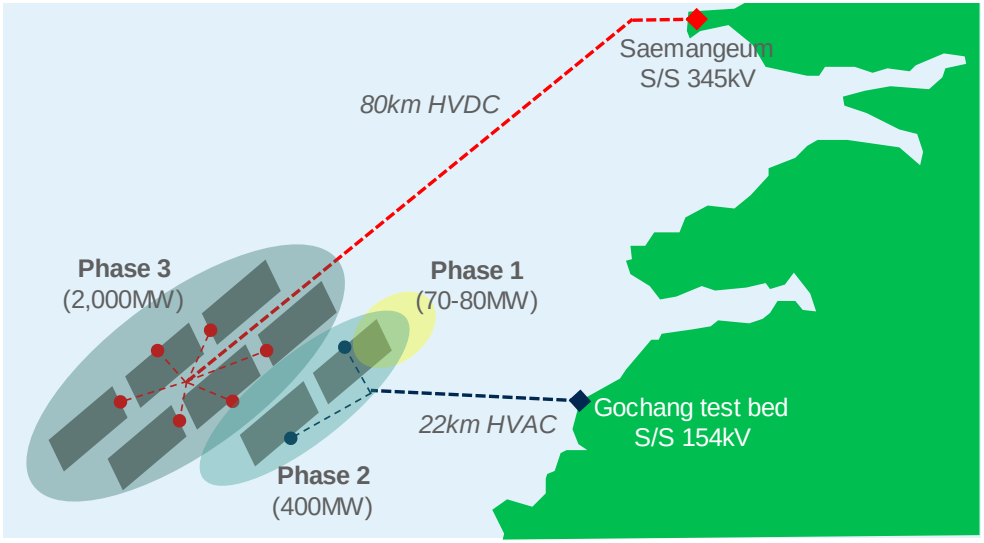
Key pipeline project is the 2.5GW Southwest project

Offshore pipeline by province



Source: MAKE, MOTIE, KOWP

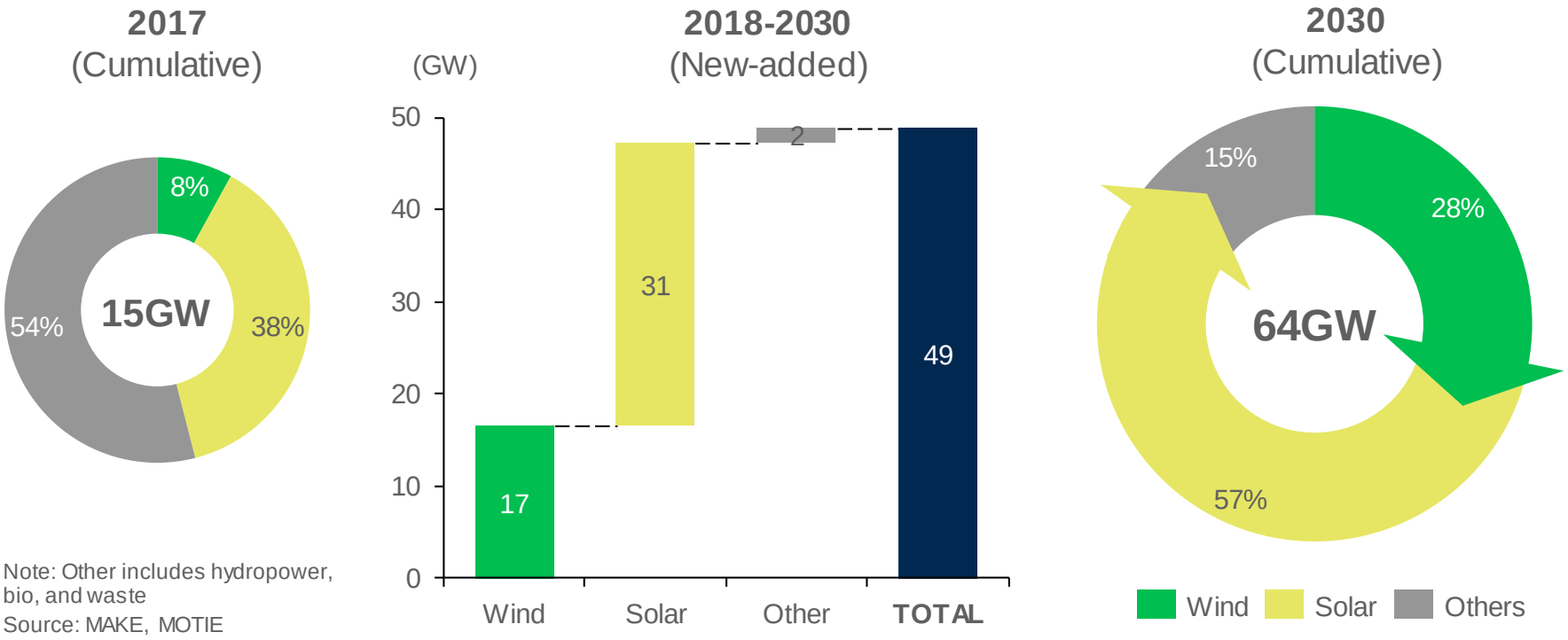
National Southwest project



	Phase 1	Phase 2	Phase 3
Purpose	Demonstration	Build track record	Large scale deployment
Cost (USD)	384 million	1.8 billion	8.9 billion
Completion	**By 2018**	**By 2020**	**2020+**

Ambitious renewable energy targets for wind and solar

South Korea renewable energy capacity, 2017 and 2030 ”RE 3020” vision



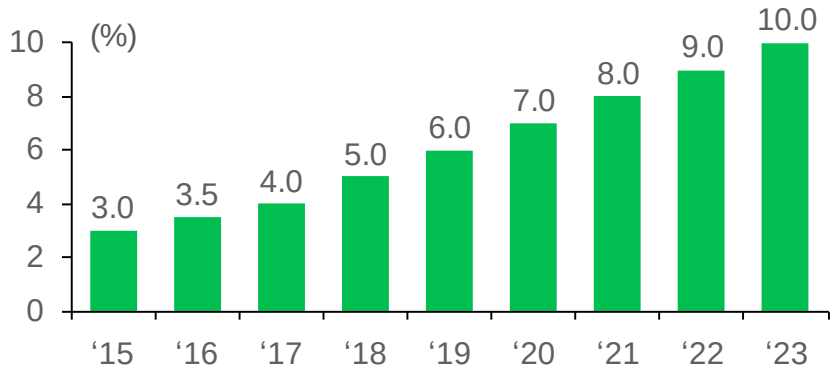
Note: Other includes hydropower, bio, and waste

Source: MAKE, MOTIE

Targeting 17GW of new added wind power capacity by 2030 would require on average >1GW of new wind power capacity to be installed every year leveraging offshore wind

Primary policy driver relies on forcing more RE on large IPPs

Renewable Portfolio Standard obligations



REC multiplier for wind power

Energy	Onshore	Offshore <5km	Offshore >5km
Wind	1	1.5	2

Note: Offshore refers to distance to grid connection

Source: MAKE, MOTIE

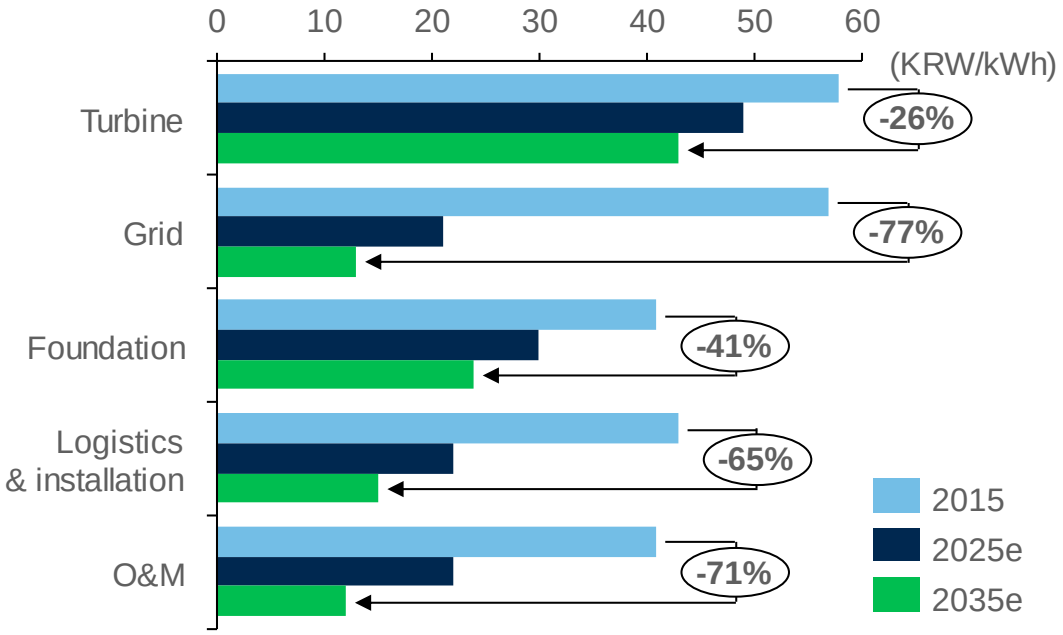
Requirements of S.Korea's RPS system

- The Renewable Portfolio Standard (RPS) scheme requires any power producer with over 500MW of capacity to gradually increase their share of RE in their generation portfolio
- Power producers receive one Renewable Energy Certificate (REC) for every 1MWh generated - though different RE sources have a higher weighting (e.g. multiplier)
- Failure to comply will result in penalty charge of 150% of average REC price though it can be deferred up to 3 years at maximum 20% of mandatory supply

South Korea is the only market in Asia Pacific that relies on Renewable Portfolio Standard system instead of a FIT for offshore projects as a policy driver

South Korean offshore wind costs need to drop significantly

South Korea LCOE offshore estimates



Source: MAKE, MOTIE

- Offshore cost estimates are still very high as they are extrapolated from demonstration units
- Given high cost of offshore LCOE, developers would much prefer a fixed guaranteed price rather than reliance on fluctuations in REC prices and electricity tariff
- Ideally, the government envisions offshore project costs to drop to around USD 3 million per MW in the long term once demonstration projects are completed to be a sustainable RE source

Expectations are that offshore LCOE in South Korea will drop by 40% by 2025 and 55% by end of 2035 with cost reductions gained from experience and economies of scale

Local turbine suppliers are anticipating offshore growth

DOOSAN

- Longest track record in offshore wind in Korea with 33MW installed and 60MW under construction using its 3MW platform
- Acquired Hyundai Heavy Industries' 5.5MW turbine that was designed with AMSC-Windtec

HQ5500-140

HYOSUNG

- Parent company Hyosung Corp. is a major conglomerate in construction, heavy industries and machinery
- 5MW offshore prototype turbine was designed with Aerodyn
- Limited track record in wind (22MW) and has left onshore wind to focus on offshore wind

HS139-5MW

UNISON

- Active in onshore wind but no track record in offshore wind
- Plans to upgrade latest 4.2MW model to 5MW with prototype planned for installation in 2018
- Looking at potential acquisition of Samsung's 7MW turbine to increase competitiveness

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